## AMENDMENTS TO THE SPECIFICATION:

*Please amend the paragraph beginning at page 1, line 2, as follows:*

The invention relates to a frequency tracking device for a receiver of a ~~multi-carrier~~ multi-carrier communication system. The frequency tracking device evaluates and corrects frequency deviations which are introduced into multi-carrier symbols when they are transmitted between a transmitter multi-carrier filter bank and a receiver multi-carrier filter bank. These multi-carrier symbols are generated in the transmitter and are decoded in a receiver by using multi-carrier modulation/demodulation techniques.

*Please replace equation (1) beginning at page 5, line 17, as follows:*

$$\chi_{rec,n}(i) = d_n(i)C_n(i)e^{j\,i(N+G)\Delta\varphi}\,Si\left(N\frac{\Delta\varphi}{2}\right) + \underbrace{ICI_n(i) + n_n(i)}_{n'_n(i)} \quad (1)$$

*Please replace equation (6) beginning at page 9, line 26, as follows:*

$$\Phi_{est,1}(i) = \frac{1}{N_{used}} \sum_{n=0}^{N_{used}-1} \arg\{x_{rec,n}(i)(d_{dec,n}(i)C_{est,n}(i))^*\} \qquad (6)$$

*Please amend the paragraph beginning at page 10, line 19, as follows:*

A second example to determine the phase estimate $\cancel{\theta}\underline{\Phi}_{est,2}$(i) is a correlation of the received data of all sub-carriers with the decided data and the channel coefficients of all (used) sub-carriers. This second type of phase estimate can be calculated in accordance with the following equation:

*Please replace equation (7) beginning at page 10, line 24, as follows:*

$$\Phi_{est,2}(i) = \arg\left\{\sum_{n=0}^{N_{used}-1} x_{rec,n}(i)(d_{dec,n}(i)C_{est,n}(i))^*\right\} \qquad (7)$$



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*Please amend the paragraph beginning at page 11, line 6, as follows:*

A third example for determining a phase estimate ~~θ~~$\underline{\Phi}_{est,3}(i)$ uses received pilot data together with the channel coefficients and the sent pilot data. For one OFDM symbol the result is averaged over all pilot carriers $N_{pilot}$ of that symbol. The third example of the phase estimate is calculated in accordance with the following equation:

*Please replace equation (8) beginning at page 11, line 12, as follows:*

$$\Phi_{est,3}(i) = \frac{1}{N_{pilot}} \sum_{n=0}^{N_{pilot}-1} \arg\{x_{rec,n}(i)(p_n(i)C_{est,n}(i))^*\} \qquad (8)$$

*Please amend the paragraph beginning at page 11, line 15, as follows:*

The following fourth example of a phase estimate ~~θ~~$\underline{\Phi}_{est,4}(i)$ is using the received pilot data in a correlation with the channel coefficient and the sent pilot data, similarly as was done for the data symbol evaluation in equation (7). That is, a correlation of the received pilot data with the channel coefficient and the sent pilot data can be calculated in accordance with the following equation:

*Please replace equation (9) beginning at page 11, line 22, as follows:*

$$\Phi_{est,4}(i) = \arg\left\{\sum_{n=0}^{N_{pilot}-1} x_{rec,n}(i)(p_n(i)C_{est,n}(i))^*\right\} \qquad (9)$$



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*Please amend the paragraph beginning at page 12, line 12, and continuing to page 13, line 5, as follows:*

Fig. 2 shows a first example of a correction unit 13 arranged upstream <u>of</u> the receiver multi-carrier filter bank 8. On the basis of the frequency deviation estimate $f_{off,est}$ ~~(~~determined by using equation (5) and the sample index (k) within the multi-carrier symbol each received multi-carrier symbol is rotated with a different phase shift. That is, in Fig. ~~1~~ <u>2</u> the correction of the offset is performed in a feedback loop before the FFT unit 8. Such type of correction is used in the aforementioned patent documents. In fact, this type of correction is a straightforward rotation of each incoming sample of the i-th multi-carrier symbol with a value which has been obtained from the offset estimates of the symbols at an adjustment time interval before. That is, since the multi-carrier symbols arrive as sets of N multi-carrier symbols at each multi-carrier symbol duration, the evaluator 14 operates on the set of multi-carrier symbols received at a last symbol duration and the correction with the frequency offset estimation $f_{off,est}$ is carried out on the next set of arriving multi-carrier symbols.

*Please amend the paragraph beginning at page 14, line 1, as follows:*

As can be seen from equations (6), (8), the phase estimates ~~⊖~~<u>$\Phi$</u>$_{est,1}$ and ~~⊖~~<u>$\Phi$</u>$_{est,3}$ are based on the summing up of the arguments of the received data with their decided data corrected by the channel coefficients (8) $X_{rec,n}(i)$ denotes the received pilot data on the n-th sub-carrier of the i-th symbol. Since the first and third examples of the phase estimates therefore do not process probability information, in frequency selective environments the data transmitted on the sub-carriers with small channel coefficients (where noise badly distorts the received signal), is equally weighted as the data on sub-carriers with large channel coefficients, where the influence of the noise is small and



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where thus, in case of the example 1, false decisions are less likely. Since the second and fourth phase estimates are based on a processing of probability information and inherently weight the sub-carriers with the channel coefficients, the performance can be improved. Although sub-carriers with small channel coefficients are not weighted as much, they can distort the phase estimate due to false decisions in case of a decision directed approach in the second example.

*Please amend the paragraph beginning at page 27, line 16, as follows:*

In step S4 the evaluator BVAL determines on the basis of the M selector sub-carriers and the corresponding M channel coefficients an estimate ~~$\Phi$~~$\underline{\Phi}_{est,off}$ of the frequency deviation $f_{off}$ introduced in the multi-carrier symbols. For the evaluation process in the evaluator EVAL any of the above-mentioned four examples for providing phase estimates, ~~$\Phi$~~$\underline{\Phi}_{est,1}$, ~~$\Phi$~~$\underline{\Phi}_{est,2}$, ~~$\Phi$~~$\underline{\Phi}_{est,3}$, ~~$\Phi$~~$\underline{\Phi}_{est,4}$, as described with equations (6), (7), (8). (9) can be used. Whilst the first and second example evaluation processes in accordance with equations (6), (7) are a decision directed evaluation, the third and fourth example evaluation in accordance with equations (8), (9) are a pilot carrier aided evaluation for the M sub-carriers, i.e. they require the knowledge of the pilot symbols $p_n$. However, as such pilot symbols are output by the FFT filter bank 8 just as any other data symbol and therefore the selector SEL must only be provided with the indices of the sub-carriers on which the pilot symbols are transmitted. Thus, the selector SEL can also select only from the number of use pilot symbols $N_{used,pilot}$ a number of $M_{pilot}$ pilot sub-carriers in accordance with the corresponding largest channel coefficients. In case of pilot aided evaluation the sub-carriers should only be selected if the number of available pilots is large enough and when the number of pilots is small all pilot carriers should be used to ensure a good averaging process.



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*Please amend the paragraph beginning at page 28, line 27, and continuing to page 29, line 19, as follows:*

In step S5 the corrector CORR performs a correction of the frequency deviation $f_{off}$ on the basis of the frequency deviation estimate $f_{off,est}$ which is based on the phase estimate determined by the evaluator EVAL (see the above equation (5)). As explained above with reference to Fig 4-1 the corrector CORR can perform a correction at the input or the output of the FFT filter bank 8. If a correction CORR1 is carried upstream of the FFT filter bank 8, then each received multi-carrier symbol is rotated with a different phase shift depending on the frequency deviation estimate $f_{off,est}$ and the sample k within the multi-carrier symbol since, as explained above with reference to equation (1), in the time domain each time domain sample k is rotated by $e^{jk\underline{\Delta\phi}\cancel{ee}}$ where k is the sample index. In case that the evaluator EVAL and the selector SEL perform a separate evaluation/selection process for a pilot carrier aided evaluation and a decision directed evaluation, two different phase estimates and consequently two different frequency deviation estimates are determined and thus the corresponding pilot multi-carrier symbols and the other multi-carrier symbols will be corrected on the basis of the respective frequency deviation estimate.



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